

Appl. No. 10/509,457
Amtd. Dated October 5, 2006
Reply to Office Action of July 5, 2006

REMARKS

Claims 1 to 10 are currently pending in the present application. Claims 1, 2 and 8 are amended herein. The amendments are supported by the application as originally filed. Therefore no new matter has been added by the amendments. Reconsideration of the present application, as amended, is respectfully requested.

Claims 1 to 10 stand rejected under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Claim 1 has been amended to claim:

A method of determining a corresponding image for a reference image from an image sequence of a moving object by means of a first and a second motion signal, in which

- the first and the second motion signal represent the respective variation in time of the states of motion of a first motion and a second motion of the object,
- the image sequence represents the first motion of the object as a sequence of images of states of motion,
- the reference image represents a state of motion from the second object motion and is acquired at a reference instant during the second motion of the object, including the following steps:
 - a. examining the first and the second motion signal for similarities, to determine a similarity function,
 - b. calculating a correspondence instant in the first motion signal by means of the similarity function, the correspondence instant corresponding to the acquisition instant of the reference image from the second motion signal, and
 - c. defining the corresponding image by identification of the image sequence whose acquisition instant corresponds at least approximately to the correspondence instant,

wherein the corresponding image represents at least approximately that state of motion of the moving object which is represented in the reference image.

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Claim 1 is directed to a method for determining a corresponding image for a reference image, the corresponding image representing at least approximately that state of motion of a moving object which is represented in a reference image. Specifically, claim 1 relates to a method of determining a corresponding image for a reference image from an image sequence of a moving object, the image sequence representing the object motion as a sequence of states of motion. The invention further relates to a system and to an examination apparatus whereby the method can be carried out as well as to a computer program and a computer program product enabling a data processing unit to carry out the method. The method of claim 1 is used, for example, wherever an image of a state of motion is to be determined in an image sequence, the state of motion also being represented in a reference image acquired during a second, similar motion of the object. While the object performs the motions, each time a signal is determined which represents the sequence in time of the states of motion for each motion.

The invention of claim 1 provides a useful and tangible result as understood when considering the prior art methods in which only one reference instant is used for cardiac cycle. Because only one reference instant is employed by the prior art methods, the image sequences are aligned with one another at one instant only, so that differences between the two ECG signals in respect of the duration of the overall cardiac cycle on the one hand and in respect of the expansion or compression of individual segments of the motion of the heart on the other hand are not taken into account. This gives rise to undesirable and disturbing artifacts in the differential sequence.

According to the method of claim 1, from a first motion of an object there is acquired an image sequence in which each image represents a state of motion of the object motion. The succession of images then represents a motion image sequence of the object motion. While the object performs a second motion, a reference image is acquired of a state of motion which occurs during the second motion of the object. A motion signal which characterizes or represents the variation in time of the states of motion of the motion is available from the first as well as from the second motion. A signal of this kind is, for

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example, an ECG which can be acquired while the relevant motion takes place. Another motion signal is a signal produced by a breathing sensor during the respiratory motion of a patient.

During a first step of the method the two motion signals are examined for similarities. This yields a similarity function which can be used to associate with any instant of one motion signal a corresponding instant of the other motion signal in such a manner that the object has assumed at least approximately the same state of motion at the two instants. Using the similarity function, in two motions there can be determined two instants at which the object has assumed approximately the same state of motion during the respective motions. Even when the motions differ to such an extent that the motion signals of the motions are non-linearly distorted relative to one another, as opposed to known methods, the method in accordance with the invention still produces results that are suitable for evaluation.

During a second step of the method the instant in the first motion signal which corresponds to the reference instant of the second motion signal is determined. In a third step of the method, that image of the image sequence whose acquisition instant corresponds approximately to the corresponding instant is determined as the corresponding image. The corresponding image thus selected represents at least approximately that state of motion of the moving object which is represented in the reference image. When the reference image and the corresponding image from the image sequence are subtracted from one another, the subtraction image will exhibit only a very small number of artifacts which may be due to the fact that two images of different states of motion are subtracted from one another.

Applicants assert that claim 1 is now properly directed to statutory subject matter, as required by 35 U.S.C. § 101. Specifically, claim 1 produces a useful, concrete and tangible result in that it discloses a method for determining a corresponding image for a reference image, the corresponding image representing at least approximately that state of

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motion of a moving object which is represented in a reference image. Accordingly, the rejections under 35 U.S.C. § 101 of claim 1 should be withdrawn and claim 1 should be allowed.

Claims 2 to 9 are either directly or indirectly dependent on claim 1 and are patentable and directed to statutory subject matter in view of their dependence on amended claim 1.

Claim 10 stands rejected under 35 U.S.C. § 101 as being directed to non-statutory subject matter. Applicants assert that claim 10 is now properly directed to statutory subject matter as it depends directly from amended claim 1. Reconsideration and withdrawal of the rejection of claim 10 under 35 U.S.C. § 101 is respectfully requested.

Claims 1 and 8 stand rejected under 35 U.S.C. § 112 for failing to particularly point out and distinctly claim the subject matter which the applicant regards as the invention. Specifically, the Action states that the term "determining" in claims 1 and 8 are relative terms which render the claims indefinite. Claim 1 has been amended to claim steps of: *examining* the first and the second motion signal for similarities, to determine a similarity function; *calculating* a correspondence instant in the first motion signal by means of the similarity function, the correspondence instant corresponding to the acquisition instant of the reference image from the second motion signal; and *defining* the corresponding image by identification of the image sequence whose acquisition instant. Claim 8 has been amended to claim a step of *defining* a corresponding image of a moving object for a reference image from an image sequence by means of a first and a second motion signal. Applicants assert that claims 1 and 8 now definitely claim the disclosed invention. Reconsideration and withdrawal of the rejection of claims 1 and 8 under 35 U.S.C. § 112 is respectfully requested.

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Conclusion

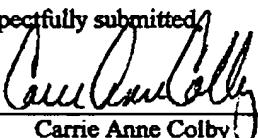
In view of the foregoing, Applicants respectfully submit that the specification, the drawings and all claims presented in this application are currently in condition for allowance. Accordingly, Applicants respectfully request favorable consideration and that this application be passed to allowance.

Should any changes to the claims and/or specification be deemed necessary to place the application in condition for allowance, the Examiner is respectfully requested to contact the undersigned to discuss the same.

Applicants' representative believes that this response is being filed in a timely manner. In the event that any extension and/or fee is required for the entry of this amendment the Commissioner is hereby authorized to charge said fee to Deposit Account No. 14-1270. An early and favorable action on the merits is earnestly solicited.

If the Examiner should have any questions concerning this communication or feels that an interview would be helpful, the Examiner is requested to call David Barnes, Esq., Intellectual Property Counsel, Philips North America Corporation at the number below.

Respectfully submitted,

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